Water-Soluble Aerosol Organic Matter from Wildland Fire Emissions as Observed using Ultrahigh Resolution Orbitrap Elite Mass Spectrometry

LYNN MAZZOLENI[1*], ELENA KIRILLOVA[1], SIMEON SCHUM[1], MARYAM KHAKSARI[1], DEEP SENGUPTA[2], CHIRANJIVI BHATTARAI[2], VERA SAMBUROVA[2], ADAM C. WATTS[2], HANS MOOSMÜLLER[2], AND ANDREY KHLYSTOV[2]

[1]Department of Chemistry, Michigan Technological University, Houghton Michigan, USA
[2]Division of Atmospheric Science, Desert Research Institute, Reno, NV, USA
*Correspondence: lrmazzol@mtu.edu

Wildland biomass burning, in the form of wildfires or prescribed burning, is an important emission source of organic aerosol to the atmosphere contributing to climate change, visibility reduction, and adverse human health effects. The molecular chemistry of atmospheric aerosol is important because it can be used to better understand its lifecycle and the physical properties of aerosol in the atmosphere. In this work, we investigated the molecular properties of water-soluble aerosol organic matter (AOM) for five globally important fuels: Alaskan peat, Russian peat, Florida swamp peat, wildland cheat grass, and Ponderosa pine needles.

Aerosol from laboratory controlled combustion experiments was collected on filters and extracted in ultra-high purity water. Ultrahigh resolution mass spectrometry was performed after a 2-step solid-phase extraction procedure. Thousands of molecular formulas were assigned to the mass spectra collected after electrospray ionization, atmospheric pressure chemical ionization, and atmospheric pressure photoionization. CHO compounds were the most dominant fraction by number, followed by CHNO and CHOS compounds. In all cases, a high molecular diversity of compounds was eluted in the first elution, while less oxidized and more aromatic molecules with lower average O/C and H/C ratios were eluted in the second fraction with alkaline methanol. Overall, most of the assigned molecular formulas demonstrated low O/C ratio (< 1) typical for fresh biomass combustion aerosols. The three peat burning aerosol samples which only smoldered showed molecular similarity, as did the two wildland fuel samples, which both flamed and smoldered, indicating that AOM corresponds to differences in combustion.